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UNITED STATES DEPARTMENT OF AGRICULTURE
✓ Bureau of Agricultural Economics

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ESTIMATED LAGS BETWEEN FARM, WHOLESALE, AND RETAIL PRICES FOR SELECTED FOODS

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Washington, D. C.
June 1943

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OCT 14 1944

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By
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PRELIMINARY

Wartime price fixing has focused new attention on the timing of price movements at different market levels. Emergency price-control measures bring the question into prominence because of the effect which timing of purchases may have in contributing to abnormal profits or losses under wartime price-ceiling orders. A "freeze" order, such as the general maximum price regulation, is extremely convenient for temporary emergency use by a price-regulating body as it relieves the price authority of the necessity for setting different ceiling prices for each locality, for each type of marketing agency, and for each market level.

Such a freeze operates upon the implicit assumption that prices at different market levels are in a "normal" relationship to each other in the period selected as a base for the freeze. To the extent (1) that prices at different levels move concurrently, or (2) that there may have been a period of fairly constant prices precoding the base period, the assumption may be fulfilled. Condition (2) is not likely to be found in practice, particularly in agricultural products, as even regular seasonal movements would appear to rule it out. To the extent that prices at different levels regularly lead or lag behind each other condition (1) is not fulfilled and either "squeezes" or "abnormal profits" will be frozen into the price-fixing scheme. 1/

PRICE TIMING AND PRICE THEORY

It should be noted that there is no necessary connection between the cause of a price change and the particular market level at which the change is first registered. For example, the occasion for a price change may be an increase in demand at retail. The first reaction of the retailer may be simply to sell more at the same price until it becomes necessary to replace his stock. When he and other retailers buy more in the wholesale market their keener competition will tend to force the price up so that an increase in demand at the retail level may be reflected in an increased wholesale price before the retail price itself rises.

Likewise a change in price occasioned by a decreased supply may be registered first at the wholesale level rather than at the farm level. Country buyers, whether acting independently or as agents for terminal market dealers, generally base their offers on prices prevailing in the terminal markets. Light receipts at any individual country point would not warrant payment of higher prices by the country buyer in order to attract more offerings. It is only when the combined receipts at the terminal market fall off that the true supply situation is known (although it may be anticipated at times by buyers or sellers who are good forecasters). A lag from a few hours to a few days might be expected in country-point prices behind terminal-market prices. Accurate price data to check this conclusion are not available on a national basis. Studies made of various local commodity markets, however, show that farmers achieve better average prices by selling f.o.b. in a falling market and by selling on a consignment in a rising market. This would seem to substantiate the existence of such a lag.

1/ Office of Price Administration "freeze" orders are devices used to avert speculative price rises and to allow time to work out a better adjusted permanent maximum price regulation. Where such an order is revoked within a reasonable time the comments in this paragraph are not relevant.

PRICE POLICIES OF RETAILERS

The most important element influencing the timing of retail price changes in relation to wholesale price changes is the price policy of the retailer. Very few studies are available on the price policies of retail food dealers and most of these require some interpretation to shed any light on the problem of timing.

Common observation and a priori reasoning lead to the conclusions that retailers as a whole are reluctant to initiate price changes and are probably more reluctant to initiate price advances than price declines. When the retailer first sets his price he presumably exercises his best judgment and it may require some fairly strong stimulus to make him revise this judgment. Except for a change in the wholesale price, the circumstances which might cause the retailer to revise his price may be fairly few. On the upward side the chief reasons may be summarized as: (1) An increase in demand. It has already been shown how such an increase may be registered first in the wholesale price, as the retailers first reaction may be merely to sell more at the previously established price. On perishables, however, the retailer may have had a regularly established practice of disposing of unsold goods at cut prices at the end of the day or week. Improved demand may remove all the produce from the store, thus obviating the necessity for the "regular" price cut on unsold perishables. This represents an increase in the average retail price but it is doubtful whether any retail price reporting now in use is sensitive enough to record such increases before the wholesale price changes; (2) the dropping of an existing "price war" by actual or tacit agreement. Occasions of this sort may result in some isolated instances in which a rise in retail prices precedes a wholesale price rise. Generally, however, "price wars" are local in character unless sponsored by competing manufacturers, and are not likely to be reflected in a national retail price average; (3) the discovery by some retailers that they are "under-priced" as compared with their competitors. This also is apt to be a very minor influence which would not be reflected in price averages, unless the movement became cumulative. Downward movements by other retailers who discovered that they were "over-priced", might be expected on balance to equal the upward revisions providing that retailers are motivated to maintain the existing structure of competition.

The results of the food prices studied, within the limitations of the data, seem to confirm the impression that retailers as a whole, do not initiate price changes in an upward direction. In only one commodity, bread, was there any statistical evidence of a tendency for retail prices to lead wholesale prices when prices were rising. In the case of bread, the wholesale price sample was not so inclusive as the retail price sample. Also, it is not known whether price rises at retail were initiated by retail bakers or by grocery stores when such rises did occur ahead of rises in the wholesale price .

price

Most of the literature on retail/policy for food stores, both in the trade journals and in other sources 2/ deals with the question in terms of attaining certain "mark-ups over cost." If these articles reflect the type of thinking of the average retailer retail prices might be expected to change concurrently with or to lag behind wholesale price changes, depending on how the retailer defines cost.

2/ See for example various articles by C. F. Phillips on chain and independent store prices in Harvard Business Review and The Journal of Business of Chicago University.

If the retailer bases his mark-ups on replacement cost, his prices will change concurrently with wholesale prices or will lag behind them, depending on the source of information used for replacement cost. If the retailer keeps in active touch with daily price quotations on wholesale markets as a source of information for replacement costs, his prices will tend to move concurrently with wholesale prices. If he gets his price information only when the wholesalers' salesmen call upon him, his prices will tend to lag behind the wholesale price. If he takes the trouble to ascertain prices only when placing an order, his prices will tend to lag still further and will depend to a considerable extent on the rate at which stocks are replaced. If he follows this last course, the tendency would be for less lag when prices are rising due to increased demand and stocks are replaced more often, and longer lags in periods of slack demand when stocks are replenished less rapidly.

When it is considered that the average independent retailer will have from 800 to more than 1,000 different items in his store, it is reasonable to suppose that, unless he is exceptionally energetic, he does not become aware of wholesale price changes on most items until he places a new order for them. Chains and supermarkets can, of course, afford to have someone specialize in following current prices.

If the retailer follows the policy of basing his mark-ups on original cost, his price changes will lag much farther behind wholesale price changes than if he attempts to use replacement cost.

Generally, no retailer who attempts to base his mark-ups on original cost will follow the practice so rigidly as to have different prices for different units of the same commodity which have been bought at different times. This has led some observers to describe a practice of "mark-ups" over average cost." It may be doubted whether any retailer bothers to compute an average cost of his inventory on any item for the purpose of setting the price. It is more likely that a retailer who attempts to follow the practice of mark-ups over original cost actually uses what might be called "mark-up over invoice cost" at the time of the receipt of new stock.

There is no reason to expect retailers to follow a consistent mark-up policy or to expect that they will be able to do so even if they so desire. On price rises most retailers would probably like to use the replacement cost basis. Even if they attempt to follow this policy the timing of the rise will depend upon the source of their wholesale price information. Those retailers, however, who observe the market most closely (or whose stocks are exhausted first so that price changes are forced on their attention) may find that other retailers are not yet changing their prices and competition may prevent the first retailers from making changes until market information has been acted upon by their chief competitors.

On the downswings the dealers might be expected to prefer an original cost basis. It is generally conceded that the knowledge of "when to take a small loss in order to avoid a greater loss" is one of the rarest attributes of merchandising ability in any line. Even if all merchants attempt to follow the policy of mark-up over original cost in the downtrend, it is unlikely that all will be able to do so. Those retailers whose stocks are exhausted first will have lower original cost on the new inventory than those with heavy stocks on hand still to be disposed of. The dealers with heavy inventories acquired at former higher prices find themselves faced with competition, either with other retailers whose stocks were exhausted earlier, or possibly with some other retailers who are selling on a replacement cost basis.

On the basis of a priori reasoning, therefore, retail prices could be expected to lag behind wholesale and farm prices in varying degrees. Also we should expect the lag to be shorter in periods of rising prices and longer in periods of declining prices. Considering the limitations of the data these expectations are fulfilled in a surprising degree in the analysis of individual food prices, the results of which are given in the following discussion.

PRICE LAGS FOR INDIVIDUAL FOODS

As a first approximation simple correlation coefficients of monthly retail, wholesale, and farm prices with various periods of lag were computed. The ideal data for this purpose would have been weekly average prices. Daily retail price data, even if available, would probably be colored by selling habits on different days of the week. Any data for periods longer than a week tend to obscure the exact timing of the actual lag. As monthly figures, for the most part, had to be used the expedient was adopted of interpolating to estimate the lag corresponding to the highest correlation coefficients. A check on this method by the use of bimonthly data, where available, tended to confirm the accuracy of the interpolation.

For each commodity under consideration, wholesale and retail prices prevailing during concurrent months were first correlated. Then wholesale prices were correlated in turn with retail prices prevailing 1 month earlier and from 1 to 6 months later than wholesale. The same procedure was followed with farm and retail prices. 3/ In addition, wholesale and retail price changes (first differences) rather than actual prices were correlated in the manner described above. Price changes were then classified by months in which there was an increase and months in which there was a decrease in wholesale prices, and separate lagging correlations were made for price changes falling in these two classifications.

As would be expected, retail prices for those items which must be replaced frequently by retailers appear to lag very little, if any, behind wholesale prices because changes in replacement costs are often reflected almost immediately in the retail price. Retail prices for eggs, bread, and oranges, appear to be most closely associated with wholesale prices prevailing during concurrent months (table 1, also see charts in discussion for each commodity). Farm and retail prices of eggs and oranges also seem to be most closely correlated during the same months. The price of bread appears to be most highly correlated with the price paid farmers for wheat about 4 months earlier.

3/ Farm, wholesale, and retail prices were adjusted in such a manner as to make them approximately comparable with respect to units in which prices were quoted. For each of the three groups - pork, beef, and dairy products, blended wholesale and retail prices consisting of weighted averages for the principal wholesale and retail products obtained from hogs, steers, and whole milk and butterfat were constructed. Differences between the adjusted farm, wholesale, and retail prices indicate the approximate spread between prices at these levels. The objective of the present analysis, however, was not to determine farm-to-retail and wholesale-to-retail spreads, but the extent to which changes in retail prices lag behind changes in wholesale and farm prices.

Table 1.- Time lag in weeks between farm, wholesale, and retail prices for selected foods ^{1/}

| Commodity | Actual prices | | | | Price changes (first differences) | | | | | |
|---------------------------|-----------------------|-------|----------------------------|-------|-----------------------------------|-----------------------------|-----|-----------------------------|-----|-------|
| | Lag retail after farm | | | | lags retail after wholesale | | | | | |
| | Lag retail after farm | | Lag retail after wholesale | | Over-all | Increasing wholesale prices | | Decreasing wholesale prices | | |
| | Weeks | | Weeks | | | Weeks | | Weeks | | |
| Pork. | 2 | to 3 | 2 | to 3 | 1 | to 2 | 0 | | 4 | to 5 |
| Beef. | 4 | to 5 | 2 | to 3 | 3 | to 4 | 0 | | 4 | to 5 |
| Dairy products. | 1 | to 2 | 1 | to 2 | 1 | to 2 | 1 | to 2 | 4 | to 1 |
| Potatoes. | -1 | to 0 | 1 | to 2 | 0 | | 0 | | 3 | to 4 |
| Tomatoes, canned. | --- | | 3 | to 13 | (15 | to 20 | (15 | to 20 | (15 | to 22 |
| Peas, canned. | --- | | 12 | to 26 | (3 | to 6 | (3 | to 6 | (0 | to 3 |
| Bread. | 14 | to 22 | -4 | to 2 | -2 | to 0 | -2 | to 0 | -4 | to 0 |
| Eggs. | 0 | | 0 | | 0 | | -1 | to 0 | 0 | |
| Oranges. | --- | | 0 | | 0 | | -1 | to 0 | 0 | |

^{1/} Lags indicated by highest correlation coefficients for monthly prices, period 1931-41 interpolated

Figures preceded by a minus sign indicate that the retail price preceded the wholesale price by that amount.

Source of data: Retail prices BLS. Wholesale prices BLS. and AMA.

Retail prices for items of which the supplies are not replenished so frequently lag behind wholesale and farm prices in varying amounts. Over a period of time, changes in retail prices of pork, beef, and dairy products follow wholesale prices by about 1 to 3 weeks. Separate correlations of increases and decreases in wholesale prices with changes in retail prices indicate that when wholesale prices are increasing retail prices lag very little. On the other hand, when wholesale prices decrease, the highest correlation is found with an average lag of around a month in the prices of beef and pork. The same tendency is evident for potatoes.

Variations in relationships for canned tomatoes and canned peas were not such as to permit definite conclusions with respect to correlations of price change. However, it appears from the correlations of actual prices that wholesale prices of canned tomatoes are most highly correlated with retail prices occurring from 2 to 4 months later. Retail prices of canned peas seem to follow wholesale prices by from 3 to 6 months.

The results just described seem to substantiate the assumption commonly made, that, in most cases, changes in farm, wholesale, and retail prices are initiated in wholesale markets. It is here that the most complete information available with respect to weather conditions, acreage, production, insect damage, wages, purchasing power, and various other factors affecting supply and demand are first known and felt. Changes in the wholesale price of nonperishable or semi-perishable commodities may not be reflected in farm and retail prices for a considerable length of time. On the other hand, prices at various levels of some of the more perishable products such as eggs seem to rise and fall almost simultaneously.

More pronounced and significant variations in correlation coefficients resulted from correlating month-to-month price (first differences) changes than from correlating actual prices, although correlations were higher in the latter case (table 2). When actual prices were correlated the business cycle and secular change in general price level exerted a considerable influence on the results. By using price changes the effect of the cycle was at least partly eliminated. Therefore, the results of correlating actual prices are more indicative of the long-term relationship, whereas coefficients secured by correlating price changes indicate more nearly the relationship with the long-time influence eliminated. A more critical determination of the lag is obtained from correlation of price changes, which show marked differences in the size of correlation coefficients for successive lags.

Regression coefficients show the extent or degree of retail price change associated with a unit change in wholesale price for various lags, whereas the correlation coefficients show the degree of uniformity in the pattern of retail price regressions. As would be expected, higher coefficients of regression were generally obtained during months in which correlations were highest, indicating that a greater amount of change usually occurs in retail prices for each unit change in wholesale prices in those relationships where correlations are highest. A few exceptions will be pointed out as each commodity is discussed separately.

Table 2.- Correlation and regression coefficients for correlation of farm wholesale, and retail prices and price changes of 9 selected commodities

| Position of retail in relation to wholesale or farm | Correlations of actual prices | | Correlations of price changes (first differences) | | | | | |
|---|-------------------------------|--------------------------|---|--|--|----------------------------|---------------------------|---------------------------------------|
| | Farm with retail | Wholesale with retail | Wholesale with retail | Increasing wholesale with retail | Decreasing wholesale with retail | Correlation with retail | Regression coefficient | Difference between coefficients |
| | | | | | | | | |
| 1 month earlier | .903 | .980 | .939 | .877 | .290 | .343 | .250 | .039 |
| Concurrent | .941 | 1.011 | .979 | .913 | .828 | .956 | .762 | .629 |
| 1 month later | .946 | .995 | .985 | .917 | .618 | .716 | .273 | .686 |
| 2 months later | .932 | .957 | .964 | .896 | .336 | .391 | .063 | .362 |
| Pork | | | | | | | | |
| 1 month earlier | .842 | .802 | .891 | .863 | .239 | .293 | .103 | .261 |
| Concurrent | .879 | .828 | .947 | .912 | .772 | .963 | .691 | .580 |
| 1 month later | .890 | .820 | .951 | .909 | .607 | .754 | .287 | .620 |
| 2 months later | .838 | .796 | .912 | .867 | .351 | .437 | .177 | .431 |
| Beef | | | | | | | | |
| 1 month earlier | .861 | .900 | .873 | .879 | .212 | .227 | .125 | .078 |
| Concurrent | .910 | .927 | .939 | .922 | .793 | .847 | .571 | .522 |
| 1 month later | .906 | .921 | .931 | .909 | .523 | .572 | .341 | .255 |
| 2 months later | .866 | .875 | .865 | .834 | .200 | .220 | .085 | .110 |
| Dairy Products | | | | | | | | |
| 1 month earlier | .876 | .534 | .760 | .602 | .094 | .061 | .314 | .393 |
| Concurrent | .944 | .596 | .917 | .727 | .665 | .431 | .879 | .489 |
| 1 month later | .781 | .488 | .864 | .681 | .259 | .168 | .094 | .526 |
| 2 months later | .582 | .360 | .724 | .568 | .006 | .004 | .305 | .373 |
| Potatoes | | | | | | | | |
| 1 month earlier | .876 | .534 | .760 | .602 | .094 | .061 | .314 | .393 |
| Concurrent | .944 | .596 | .917 | .727 | .665 | .431 | .879 | .489 |
| 1 month later | .781 | .488 | .864 | .681 | .259 | .168 | .094 | .526 |
| 2 months later | .582 | .360 | .724 | .568 | .006 | .004 | .305 | .373 |

Continued -

Table 2.-- Correlation and regression coefficients for correlation of farm wholesale, and retail prices and price changes of 9 selected commodities - continued

| Position of retail in relation to wholesale or farm | Correlations of actual price : Correlations of price changes (first differences) | | | | | | | | | |
|---|--|---------|-------------|---------|-------------|---------|---|---------|------------------------------------|---------|
| | Farm | | Wholesale | | Wholesale | | Increasing | | Decreasing | |
| | with retail | : | with retail | : | with retail | : | wholesale | : | wholesale | : |
| | Correla-: Regres-: Correla-: Regres-: Correla-: Regres-: Correla-: Regres-: Correla-: Regres-: Correla-: Regres- | tion : | tion : | tion : | tion : | tion : | tion : | tion : | tion : | tion : |
| | coeffi-: coeffi-: coeffi-: coeffi-: coeffi-: coeffi-: coeffi-: coeffi-: coeffi-: coeffi- | cient : | cient : | cient : | cient : | cient : | coeffi-: coeffi-: coeffi-: coeffi-: coeffi- | cient : | coeffi-: coeffi-: coeffi-: coeffi- | cient : |
| 1 month earlier | | | | | | | | | | |
| Concurrent | | | | | | | | | | |
| 1 month later | | | | | | | | | | |
| 2 months later | | | | | | | | | | |
| 3 months later | | | | | | | | | | |
| 4 months later | | | | | | | | | | |
| 5 months later | | | | | | | | | | |
| 6 months later | | | | | | | | | | |
| 1 month earlier | | | | | | | | | | |
| Concurrent | | | | | | | | | | |
| 1 month later | | | | | | | | | | |
| 2 months later | | | | | | | | | | |
| 3 months later | | | | | | | | | | |
| 4 months later | | | | | | | | | | |
| 5 months later | | | | | | | | | | |
| 6 months later | | | | | | | | | | |
| 1 month earlier | | | | | | | | | | |
| Concurrent | | | | | | | | | | |
| 1 month later | | | | | | | | | | |
| 2 months later | | | | | | | | | | |
| 3 months later | | | | | | | | | | |
| 4 months later | | | | | | | | | | |
| 5 months later | | | | | | | | | | |
| 6 months later | | | | | | | | | | |

continued

Table 2.- Correlation and regression coefficients for correlation of farm wholesale, and retail prices and price changes of 9 selected commodities, continued

| Position of retail in relation to wholesale or farm | Correlations of actual price | | | Correlations of price changes (first differences) | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|--|
| | Farm | | | Wholesale | | | Increasing | | | Decreasing | | |
| | with retail | Wholesale | with retail | with retail | Wholesale | with retail | wholesale | with retail | wholesale | with retail | | |
| | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | Correla-: Regres- tion : sion : coeffl- : coeffl- : client : client | | |
| <u>Eggs</u> | | | | | | | | | | | | |
| 1 month earlier | .876 | .779 | .830 | .665 | .271 | .248 | .121 | .097 | .067 | | | |
| Concurrent | .978 | .866 | .930 | .730 | .708 | .384 | .304 | .842 | .633 | | | |
| 1 month later | .819 | .724 | .779 | .596 | .356 | -.292 | .171 | .567 | .372 | | | |
| 2 months later | .553 | .487 | .495 | .364 | .019 | -.227 | -.093 | .266 | .217 | | | |
| <u>Oranges</u> | | | | | | | | | | | | |
| 1 month earlier | | | .729 | .682 | .246 | .191 | .172 | .276 | .172 | | | |
| Concurrent | | | .812 | .769 | .660 | .396 | .280 | .723 | .546 | | | |
| 1 month later | | | .722 | .682 | .330 | -.061 | -.044 | .351 | .235 | | | |
| 2 months later | | | .546 | .516 | -.063 | .190 | -.100 | .064 | .055 | | | |

1/ Monthly farm prices for farm retail correlations were not available.

RESULTS BY COMMODITIES

Table 2 and the discussion and charts which follow, present and briefly interpret the results of the analysis. It should be pointed out that these results merely show what occurs on the average with respect to behavior of farm, wholesale, and retail prices. Price relationships in particular instances and for individual establishments may vary considerably from this average. The results are presented for what they are worth in view of the limitations of the data. Weekly data, if available, might alter the timing somewhat in addition to increasing the statistical significance.

The source of prices, adjustments made to make them comparable, and prices and weights used in constructing blended prices are described below the chart of farm, wholesale, and retail values for each commodity. For some of the commodities, canned tomatoes and canned peas in particular, the wholesale price is not ordinarily the price paid by the retailer but is really a price f.o.b. cannery. This means that in certain cases the derived lags reflect combined practices of wholesalers and retailers.

Pork

Retail prices appear to lag behind farm and wholesale prices by about 2 or 3 weeks. ^{4/} Coefficients for correlations of wholesale prices with retail prices varied from 0.939 for whole-sale prices correlated with retail prices of the preceding month to 0.985 for correlations of wholesale prices with retail prices of the succeeding month (table 1 and fig. 1-A). Coefficients were slightly lower for farm-retail correlations of prices but the same general relationship in variations occurred.

Maximizing lags indicated by correlation coefficients were much more definite when price changes, rather than actual prices, were correlated. Correlations were also lower. Coefficients varied from 0.290 for correlation of wholesale changes with retail changes occurring 1 month earlier to 0.828 for correlations of changes in concurrent months, 0.618 for wholesale with retail 1 month later, and 0.391 for wholesale with retail 2 months later. (fig. 1-B)

Results of correlating increasing and decreasing wholesale changes separately with corresponding retail changes indicate that when wholesale prices are increasing, retail prices probably lag less than 1 week. On the other hand, when wholesale prices are decreasing, retail prices seem to lag by at least a month. Coefficients of correlation of increasing wholesale changes with retail changes reach a sharp peak for correlations of changes occurring concurrently. For decreasing wholesale changes the highest correlation was obtained with retail changes prevailing 1 month later. However, it should be noted that the regression

^{4/} As differences in correlations are small, the exact amount of lag is not readily apparent. This is also true of most of the series of correlations of actual prices for other commodities analyzed. It is evident, however, that farm and wholesale prices are most closely associated with retail prices occurring during concurrent months and with those occurring 1 month later, and it is probable that the lag is most often within that range. As the correlations of farm and wholesale with retail prices occurring 1 month later are slightly higher than those for wholesale with retail during concurrent months, the average lag is probably between 2 and 3 weeks.

coefficient was higher for the correlation of decreasing wholesale changes with retail changes during the same month. This would indicate that a greater amount of price change at retail seems to occur concurrently with each unit of wholesale prices than occurs when retail price is lagged by 1 month.

Figure 2 illustrates why lower correlations and more marked variations were obtained when correlating price changes rather than actual prices. Long-time movements of farm, wholesale, and retail prices of pork seem to be rather closely associated. Even retail price changes occurring 1 and 2 months later than wholesale price changes appear to remain at a rather uniform relationship to the latter, over a period of time. On the other hand, month-to-month changes in farm, wholesale, and retail prices seem to occur more independently of each other, although it is evident that a definite relationship still exists. Increases in farm or wholesale prices of pork usually result in increases in the retail price but seldom to the same degree and often not until a month later. For further discussion on pork and beef see page 17-18, Alternative Methods of Analysis.

Beef

Variations in correlations of farm, wholesale, and retail prices for beef were very similar to those which occurred in regard to pork. Farm-retail and wholesale-retail correlations of prices did not show wide variations. It appears that, over a period of time, the retail price follows the wholesale price by about 2 or 3 weeks and the farm price by possibly 4 or 5 weeks. (Fig. 3-A)

Correlations of increases in wholesale prices with corresponding changes in retail prices were highest during concurrent months but with decreasing wholesale prices the highest correlation was for retail changes 1 month later than wholesale. (Fig. 3-B) Thus it seems evident that retail prices of beef follow wholesale prices closely when prices are increasing but that they lag approximately a month when prices are decreasing. As was the case with pork, the highest regression coefficient for decreasing price change correlations was for concurrent months. Therefore, even though the correlation coefficient was highest for the correlation with retail changes 1 month later, a greater amount of change in retail price for each unit change in wholesale price takes place during the same month. This does not necessarily invalidate the fact that the decreasing wholesale price changes seem to be most closely associated with retail changes occurring approximately 1 month later, even though the quantitative response in retail price is smaller than for concurrent months.

Dairy Products

Highest coefficients for farm-retail and wholesale-retail correlations of prices were obtained for concurrent months. (Fig. 5-A) Correlations of farm and wholesale with retail prices 1 month later were only slightly lower, indicating that, over a period of time, a lag of possibly a week or two occurs. As both the composite wholesale and retail prices include such highly processed products as evaporated milk, cheese, and butter, such a lag would be reasonable.

Correlations of wholesale and retail price changes, and correlation coefficients for months of wholesale price increases and decreases computed separately, all reach a peak in correlations of concurrent months. From figure 5-B it appears that when prices are either increasing or decreasing, the retail price follows the wholesale price by possibly 1 or 2 weeks.

Potatoes

Differences in coefficients for correlations of both actual prices and of price changes were greater than for most of the other commodities considered. A sharp peak resulted for correlations of concurrent months in every case except in the series of correlations of decreasing wholesale prices. From figure 7-a it appears that retail prices follow wholesale prices by an average of 1 or 2 weeks but that no lag occurs between farm and retail prices. Thus it seems evident that the initial change takes place at the wholesale level. When wholesale prices are increasing, retail prices probably lag very little but when they are decreasing a lag of from 2 to 4 weeks may occur. (fig. 7-b).

Canned Tomatoes

Correlations of actual prices reached a peak in the correlation of wholesale prices with retail prices occurring 3 months later. Coefficients were high enough for a month shorter and a month longer lag to indicate that retail prices may lag by an average of from 2 to 4 months. Monthly farm prices of tomatoes for canning to be used in farm-retail correlations were not available.

Canned Peas

In the series of correlations of actual prices, coefficients were highest for wholesale prices with retail prices occurring 4 months later. As differences in correlations were small throughout the series, a definite lag is not readily apparent. It is evident, however, that given wholesale prices are most closely associated with the retail prices that occur from 3 to 6 months later; and it is probable that the lag is most often within that range.

Correlations of wholesale with retail and decreasing wholesale with retail price changes are highest for retail changes occurring 4 months later than the wholesale price change. When increases in wholesale prices were compared with retail changes, a peak was reached for wholesale changes correlated with retail changes 6 months later. Possibly diversity in pricing policies, rate of turn-over, size of inventories, and other factors are responsible for the lack of entirely conclusive results in the correlations of price changes.

Bread

The curve for wholesale-retail correlations of actual prices was highest for wholesale with retail 1 month earlier, indicating that the retail may lead the wholesale price by possibly 2 or 3 weeks. From the chart of farm, wholesale, and retail value it also appears that in most cases the initial change occurs in the retail price (fig. 14). It is doubtful, however, whether the sequence of price changes occurs quite as the figures indicate because most retailers probably do not change the price of bread until the bakers' price has changed. It is possible that the wholesale and retail prices used were not entirely comparable; they were the only series available. The retail price of bread is most highly correlated with the farm price of wheat occurring 3, 4, and 5 months earlier.

In all three series of correlations of price changes the highest coefficients were for wholesale with retail during the same month and a month earlier. Correlations of decreasing wholesale prices with retail changes were considerably lower than those for increasing wholesale with retail changes, which would indicate that

wholesale and retail prices of bread are more closely associated when wholesale prices are increasing than when they are decreasing.

Eggs

Farm and retail and wholesale and retail prices seem to be most closely associated during concurrent months. Curves for both series reach a peak for correlations of wholesale with retail prices occurring concurrently. This was also true for the series of correlations of price changes. The series of correlations of increasing wholesale with retail price changes was considerably lower than the series for decreasing changes. It thus appears that wholesale and retail prices are more closely related when prices are decreasing than when increasing.

A possible explanation for the close concurrent association of the farm, wholesale, and retail prices of eggs is their high degree of perishability and the relatively great importance of month-to-month variation in comparison to longer time changes in price level. The regular seasonal pattern of price movement is familiar to traders at each level of marketing.

Oranges

Actual prices and price changes at wholesale and retail are most highly correlated during concurrent months. This indicates that retail prices move up or down at the same time as wholesale prices with no appreciable lag in time. Here again, perishability is an important factor contributing to the close concurrent association. Coefficients were higher for the series of correlations of increasing wholesale changes with retail changes than for the corresponding series of correlations made for decreasing changes. Thus, as was the case with eggs, a closer relationship appears to exist between wholesale and retail prices during periods of decreasing wholesale prices than during periods when wholesale prices are on the increase.

ALTERNATIVE METHOD OF ANALYSIS

In the cases of pork and beef for which data were available on a bimonthly basis, another method of analysis was used which yielded interesting results. A multiple regression equation of the first differences was computed to show the distributed lag. The equation follows:

$$X_1 = .008 + .503X_2 + .249X_3 + .139X_4$$

where X_1 = change in retail price, X_2 = concurrent change in wholesale price, X_3 = change in wholesale price 2 weeks earlier and X_4 = change in wholesale price 4 weeks earlier. The coefficient of multiple correlation is $r = .668$.

The data were then divided on the basis of whether the retail price was changing upward or downwards with the following results:

For retail price increases $X_1 = .385 + .381X_2 + .264X_3 - .062X_4$
multiple correlation coefficient $r = .574$

For retail price decreases $X_1 = -.381 + .208X_2 + .070X_3 + .180X_4$
multiple correlation coefficient $r = .521$

Considering the fact that both the wholesale and the retail price series would be expected to have some variations which are independent of each other, the results appear to be significant. It would appear that the equations indicate a tendency both for a considerable amount of concurrent movement and a fair amount of distributed lag. As these are bimonthly data, too much importance cannot be attached to the time periods indicated. Data for a 1-week and a 3-week lag might have yielded higher correlation and regression coefficients. It is interesting to find that there is definite indication of less concurrent movement and more lag on price declines than on price increases.

Using the same technique on beef prices yielded surprisingly similar results:

For retail price changes $X_1 = -.009 + .686X_2 + .298X_3 + .216X_4$
correlation $r = .643$

For retail price increases $X_1 = .524 + .389X_2 + .221X_3 + .028X_4$
taken separately correlation $r = .513$

For retail price decreases $X_1 = -.458 + .320X_2 + .168X_3 + .265X_4$
taken separately correlation $r = .529$

- X_1 = change in retail price
- X_2 = concurrent change in wholesale price
- X_3 = change in wholesale price 2 weeks later
- X_4 = change in wholesale price 4 weeks later

In the case of both pork and beef the apparent amount of lag is somewhat more than might be expected with a perishable product. In part this may be due to reluctance by retailers to change prices after customers have accepted them.

RESULTS ARE NOT CONCLUSIVE

The results found are not considered to be definitive. They are presented for what they are worth in view of the limitations of the data. It is hoped that this report may stimulate further study in what has to date been a largely neglected field.

So far as it is possible to generalize it appears that lags or the lack of them are a function of dealers price policies, of the price information available to dealers, of consumers reaction to price changes and of the physical conditions of marketing the product. No general average lag may be postulated but each commodity must be examined separately. Lags may be expected to be different and probably shorter in periods of rising prices than in periods of declining prices. The establishment of definite lags as better data become available may make studies of price margins more significant.

Sources of Price Data

Pork (Figure 1)

The farm value shown is the monthly average price received for hogs by farmers multiplied by 1.90 lbs. Since 100 lbs. of good grade live hog yields 52.6 lbs. of principal retail pork products, approximately 190 lbs. of live weight will yield one lb. of retail pork products. The wholesale value is the value of major pork carcass products as sold to retailers at Chicago multiplied by 1.90 lbs. The average retail price of principal pork products is a blended price made up of the combined values of .125 lb. pork chops, .329 lb. whole ham, .164 lb. sliced bacon, and .300 lb. lard. Products and weights used prior to Aug. 1939 were slightly different. For detailed discussion see "Price Spreads Between the Farmer and the Consumer", R. O. Been and F. V. Waugh, July 1936, U. S. Department of Agriculture, Bureau of Agricultural Economics. Prices which make up the composite value of principal pork products are from U. S. Bureau of Labor Statistics. Farm and wholesale prices are from Bureau of Agricultural Economics.

Beef (Figure 2)

The farm value shown is the monthly average price received by farmers for beef cattle multiplied by 2.16 lbs. Since 100 lbs. of good grade live beef cattle yields 46.4 lbs. of all retail cuts, approximately 2.16 lbs. of live weight will yield one lb. of retail cuts. The composite retail price of principal beef cuts is a blended price made up of the combined values of .4564 lb. sirloin, .0469 lb. round, .0783 lb. rib roast, .0997 lb. chuck, and .3440 lb. plate for the months prior to and including Aug. 1939. For months after that date the price is made up of the combined values of .1276 lb. round, .5751 lb. rib roast, and .3395 lb. chuck. The average wholesale price per pound was obtained by multiplying the wholesale price per pound of fresh carcass steers at Chicago by the ratio of the average number of pounds of retail to the average number of pounds of wholesale cuts secured from 100 pounds of live beef. One hundred pounds of good grade live beef will yield approximately 58 lbs. of wholesale and 46.25 lbs. of retail cuts. Farm and wholesale prices are from Division of Agricultural Statistics, Bureau of Agricultural Economics, and retail prices are from U. S. Bureau of Labor Statistics.

Dairy Products (Figure 3)

The farm value of 100 lbs. of milk equivalent was estimated as equal to the value of 49 lbs. of wholesale milk and 2.0 lbs. of butterfat. Both retail and wholesale values of 100 lbs. of milk equivalent were estimated as the combined values of 15.7 qts. whole milk, .7 lb. cheese, 2.6 lbs. butter and 2.5 cans (14-1/2 oz.) evaporated milk. All retail prices are from U. S. Bureau of Labor Statistics. Wholesale prices of whole milk and evaporated milk are from U. S. Bureau of Labor Statistics. Wholesale prices of cheese and butter are from the Bureau of Agricultural Economics.

Potatoes (Figure 4)

The retail price is the average price received by retailers in 51 cities. The wholesale price is an average of monthly average wholesale prices at Boston, Chicago, New York, and Portland, Oregon. Retail and wholesale prices are from U. S. Bureau of Labor Statistics. Farm prices are from the Bureau of Agricultural Economics.

Canned Tomatoes (Figure 5)

The retail price is the average retail price for number 2 cans in 51 cities. The wholesale price is the average price, delivered at New York. Both wholesale and retail prices are from U. S. Bureau of Labor Statistics. Farm prices by months are not available.

Canned Peas (Figure 6)

The retail price is the average retail price for number 2 cans in 51 cities. The wholesale price is the average price at the cannery. Both wholesale and retail prices are from U. S. Bureau of Labor Statistics. Farm prices by months are not available.

Eggs (Figure 7)

The wholesale price is the price of fresh firsts at Chicago adjusted upward .05 cents per dozen, and the retail price the average of 51 cities. The farm price is from the Bureau of Agricultural Economics. Wholesale and retail prices are from the U. S. Bureau of Labor Statistics.

Oranges (Figure 8)

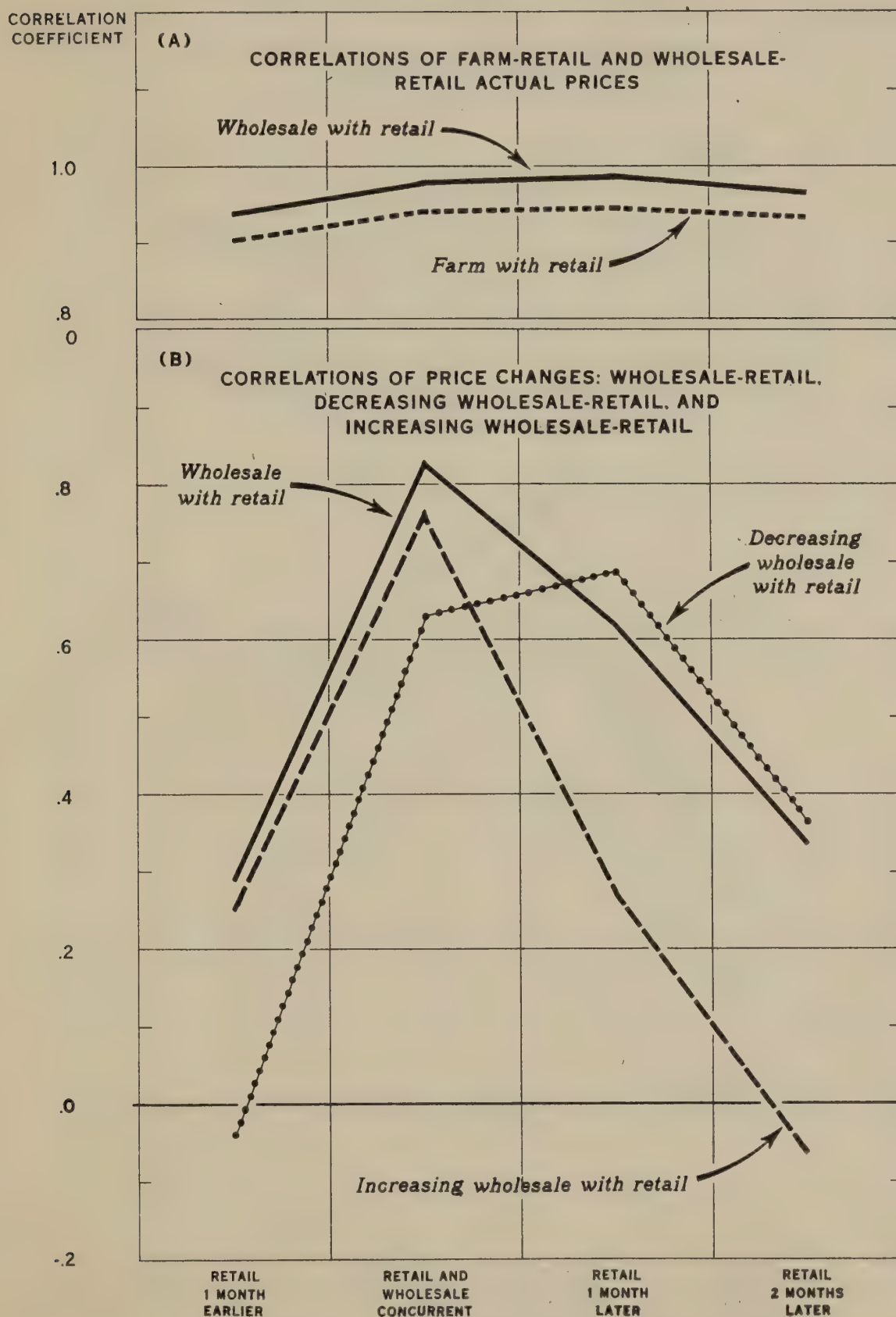
The wholesale price is the price of choice California oranges at Chicago and the retail price the average in 51 cities. Both wholesale and retail series are from U. S. Bureau of Labor Statistics.

Bread (Figure 9)

The farm value shown is the value of .97 lb. of wheat. Since 42.6 lbs. of flour obtained from one 60 lb. bushel of wheat makes approximately 62 lbs. of white bread, approximately .97 lb. of wheat is equivalent to one lb. of bread. The retail price is the average price of one lb. of bread in 51 cities. The wholesale price is the average of monthly prices of bread in Chicago, Cincinnati, New Orleans, New York, and San Francisco. The farm price is from Division of Agricultural Statistics, Bureau of Agricultural Economics. Wholesale and retail prices are from U. S. Bureau of Labor Statistics.

Figure 1

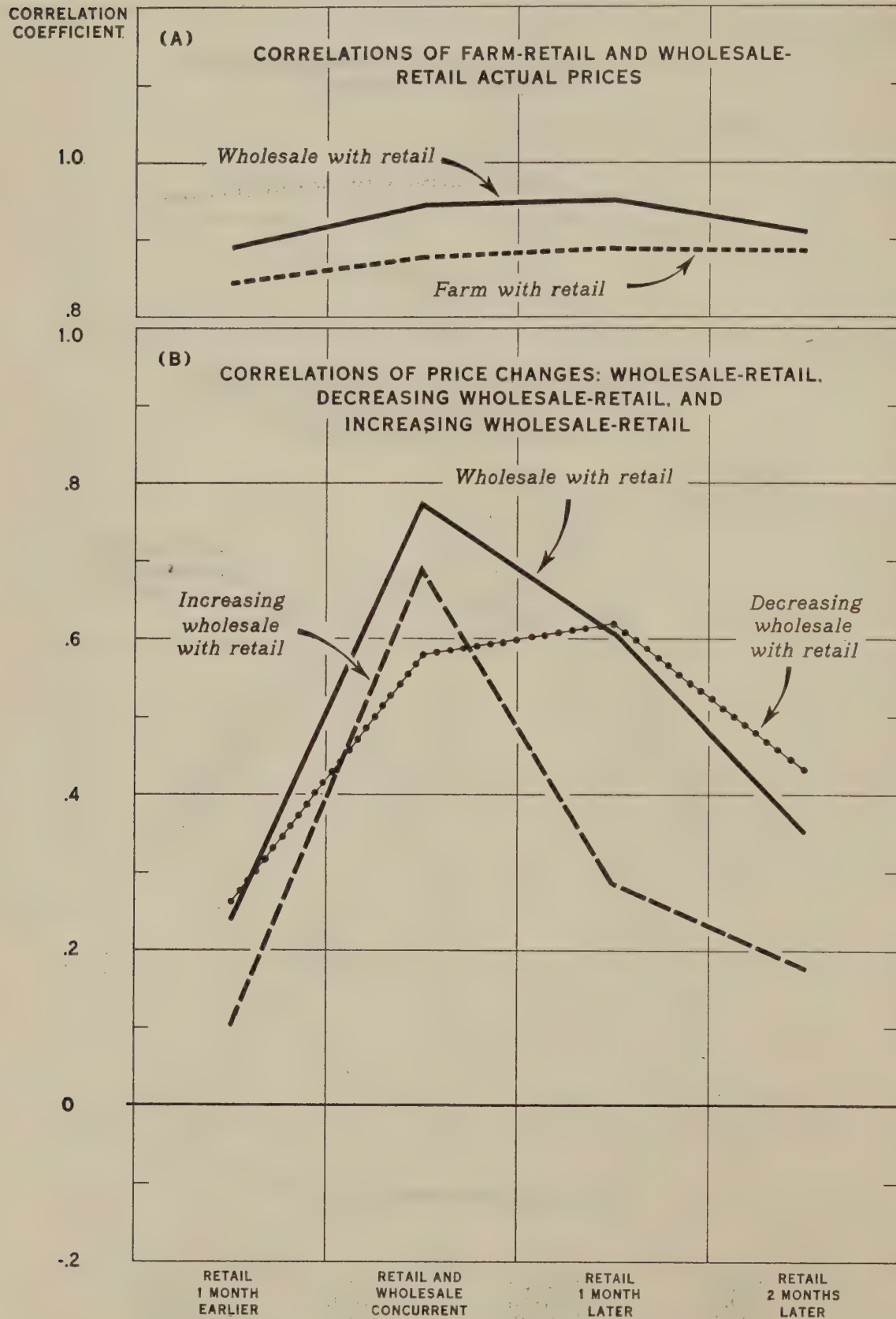
PORK: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES
AND PRICE CHANGES WITH THOSE AT RETAIL,
LAGGED FOR DIFFERENT PERIODS*



* WHOLESALE-RETAIL, JAN. 1931-DEC. 1941; FARM-RETAIL, JAN. 1931-MAY 1942

Figure 2

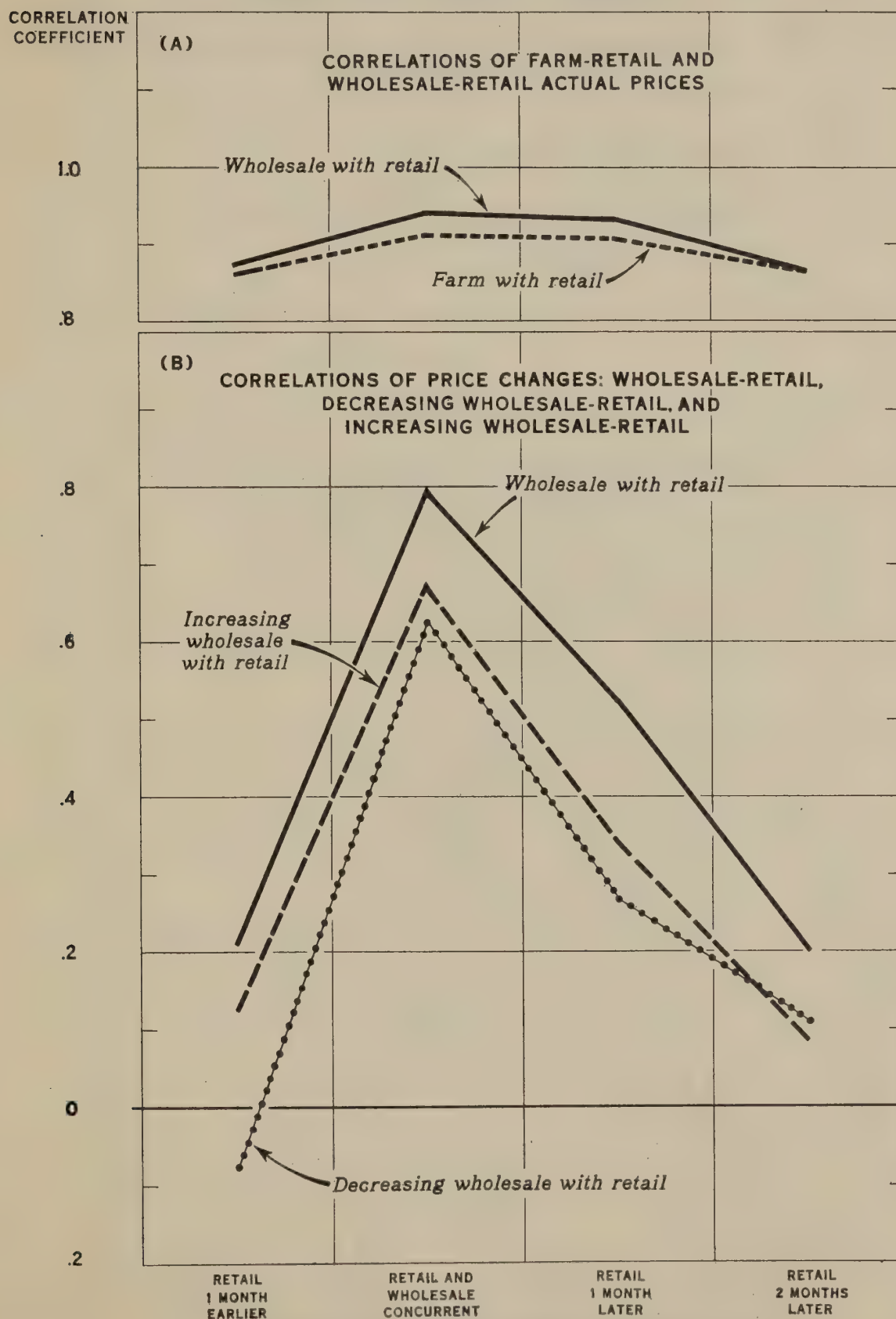
**BEEF: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES
AND PRICE CHANGES WITH THOSE AT RETAIL, LAGGED
FOR DIFFERENT PERIODS***



* WHOLESALE-RETAIL, JAN. 1931-DEC. 1941; FARM-RETAIL, JAN. 1931-MAY 1942

Figure 3

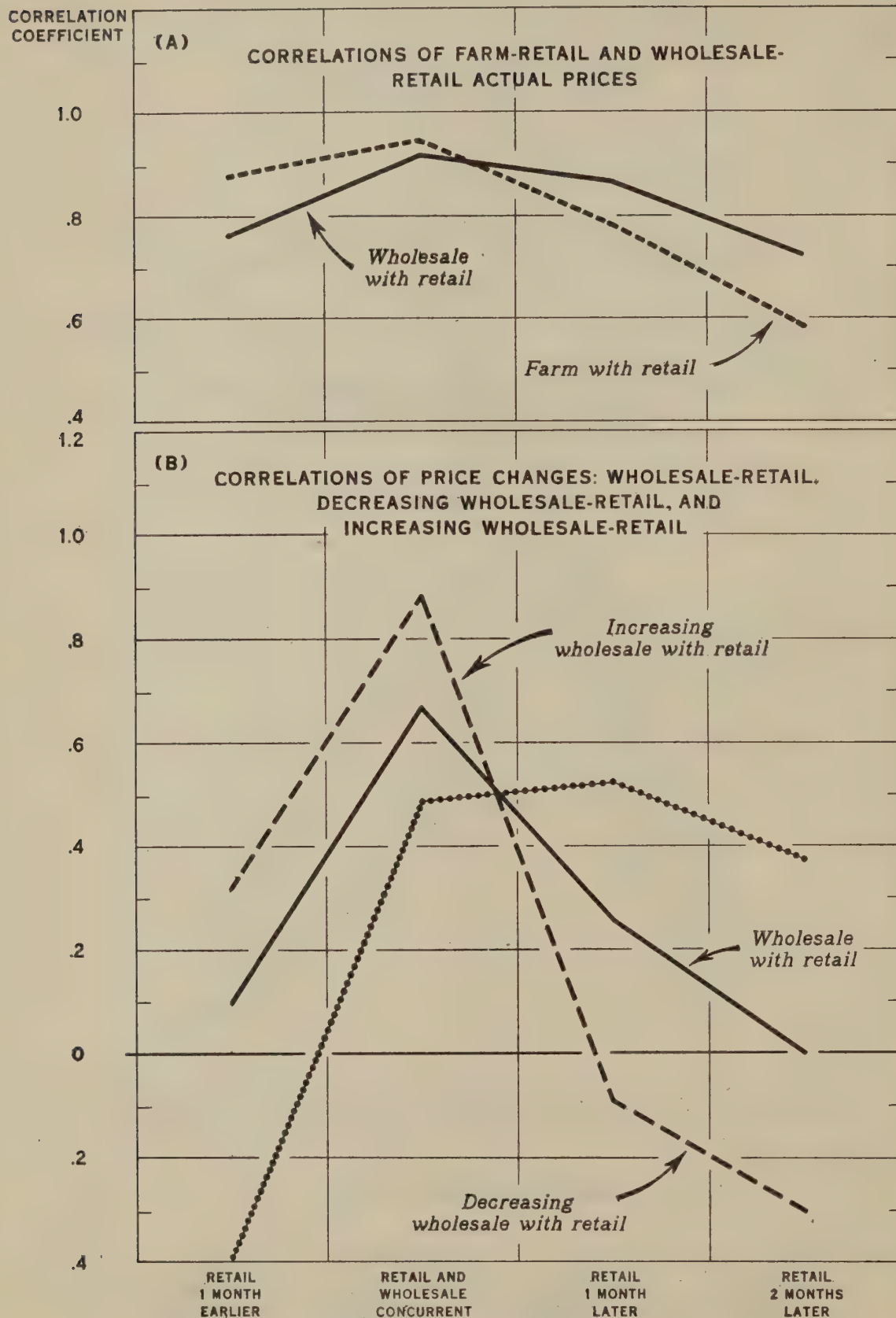
DAIRY PRODUCTS: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES AND PRICE CHANGES WITH THOSE AT RETAIL, LAGGED FOR DIFFERENT PERIODS*



* WHOLESALE-RETAIL, JAN. 1931-DEC. 1941; FARM-RETAIL, JAN. 1931-MAY 1942

Figure 4

POTATOES: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES AND PRICE CHANGES WITH THOSE AT RETAIL LAGGED FOR DIFFERENT PERIODS*



* WHOLESALE-RETAIL, JAN. 1931-DEC. 1941; FARM-RETAIL, JAN. 1931-MAY 1942

Figure 5

CANNED TOMATOES: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES AND PRICE CHANGES WITH THOSE AT RETAIL, LAGGED FOR DIFFERENT PERIODS*

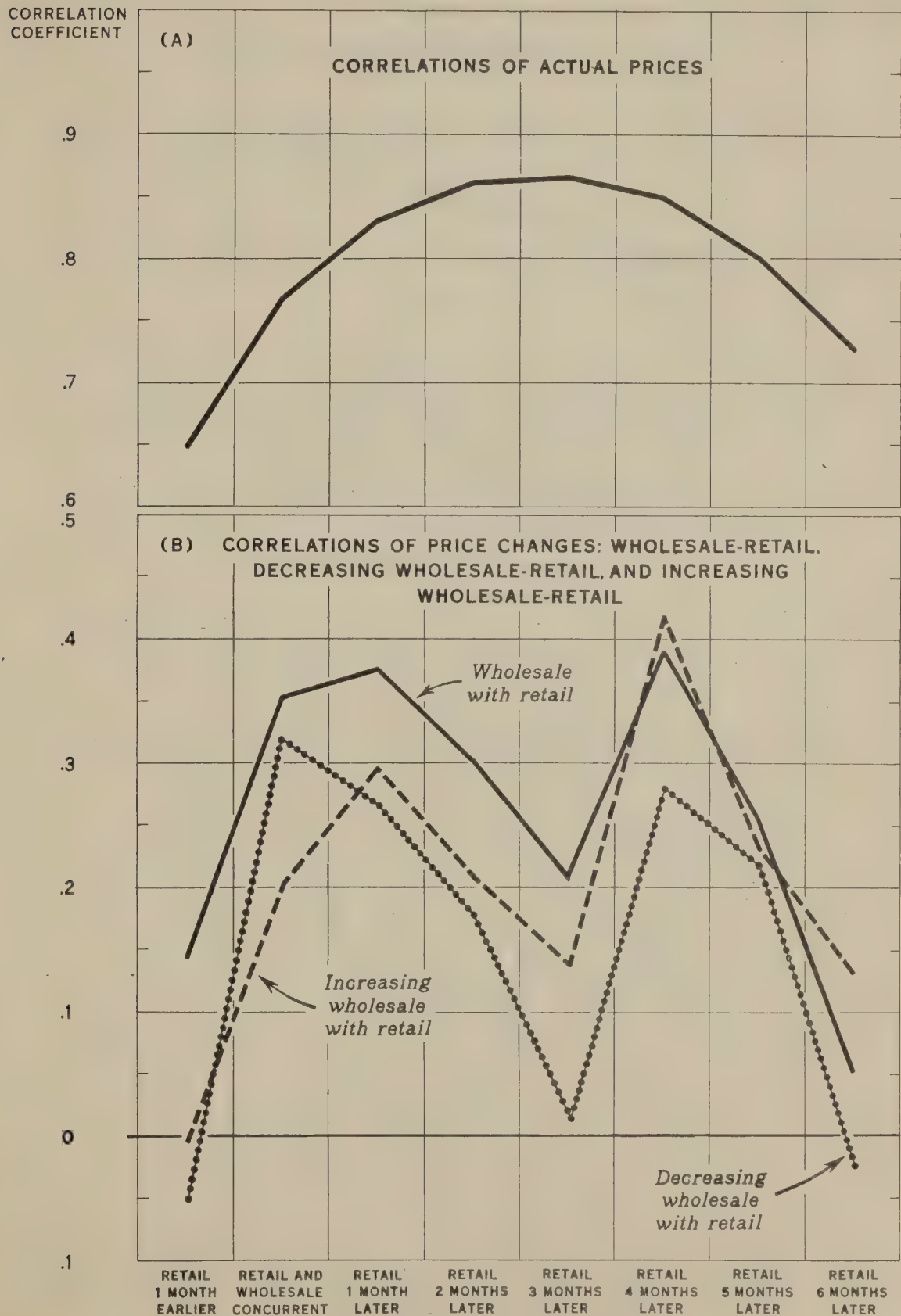


Figure 6

CANNED PEAS: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES AND PRICE CHANGES WITH THOSE AT RETAIL, LAGGED FOR DIFFERENT PERIODS*

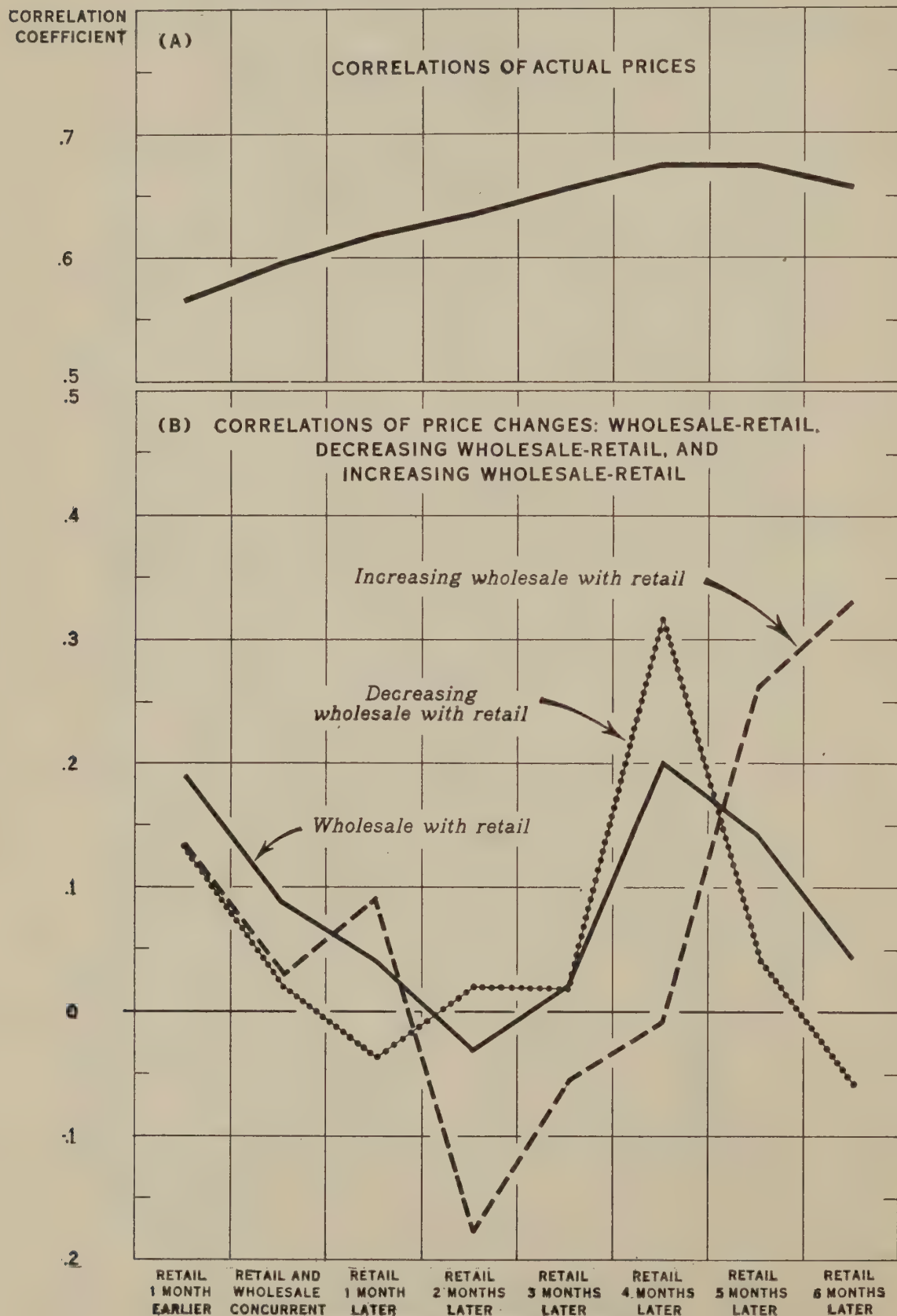
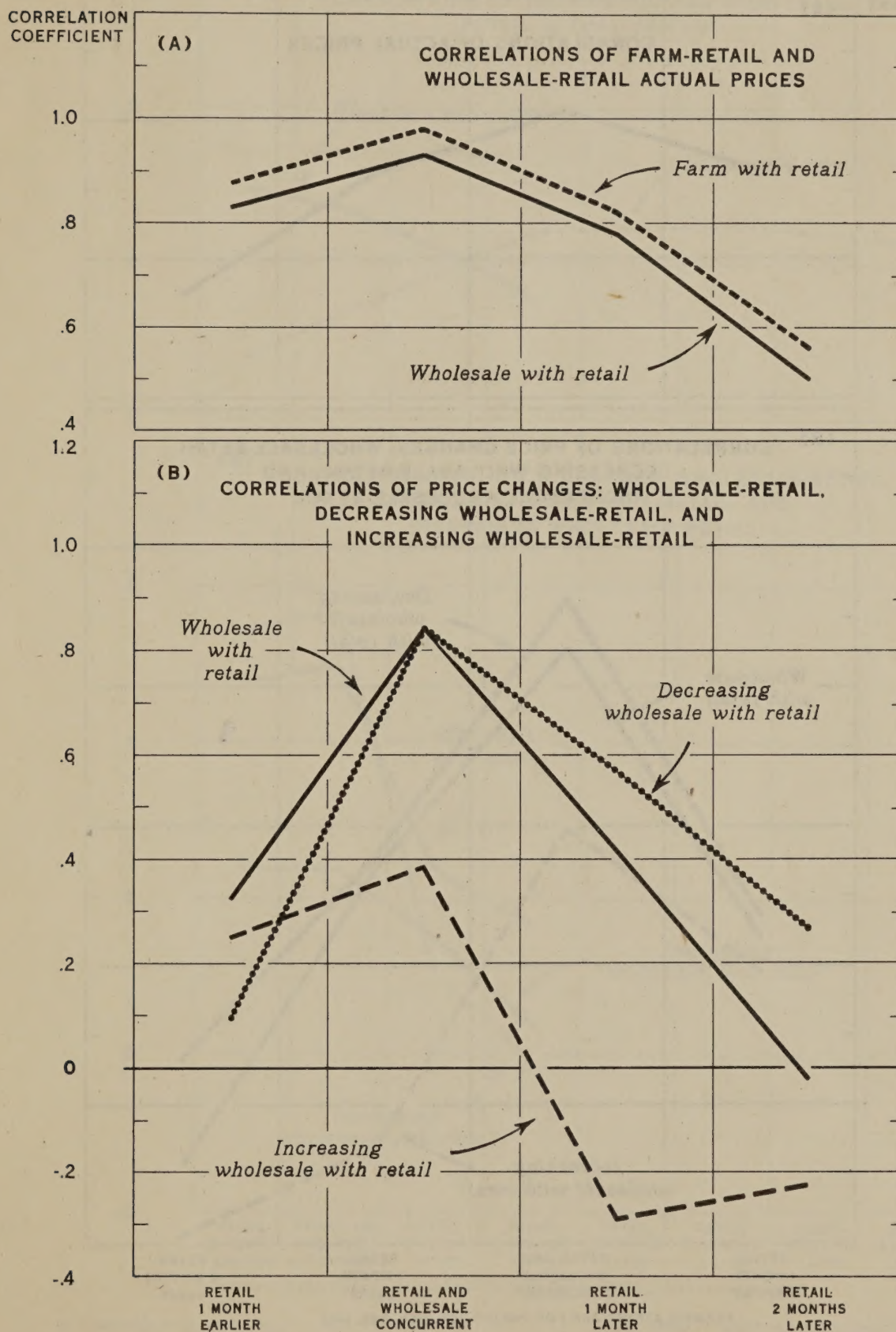


Figure 7

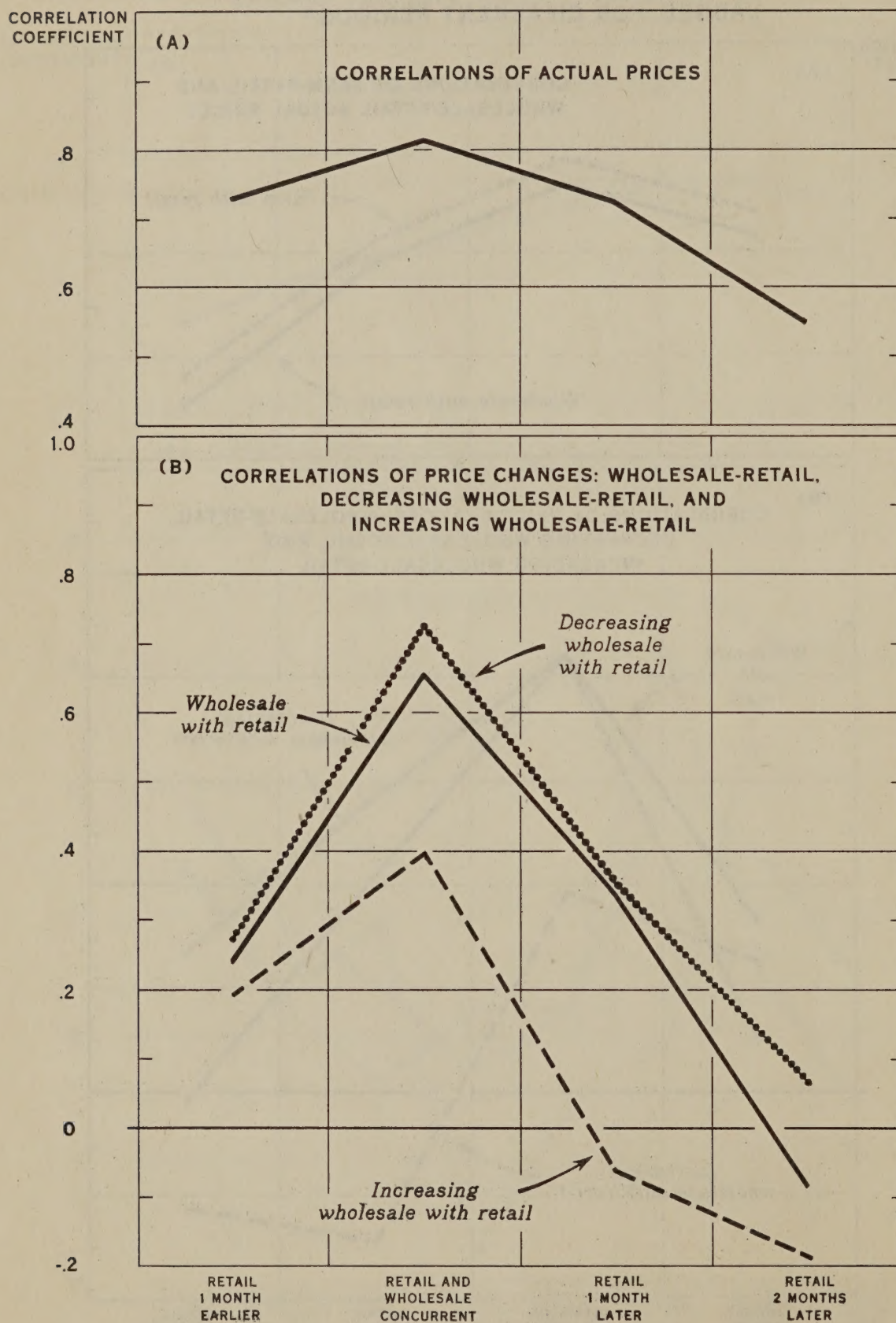
EGGS: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES
AND PRICE CHANGES WITH THOSE AT RETAIL.
LAGGED FOR DIFFERENT PERIODS*



*WHOLESALE-RETAIL, JAN. 1931-DEC. 1941; FARM-RETAIL, JAN. 1931-MAY 1942

Figure 8

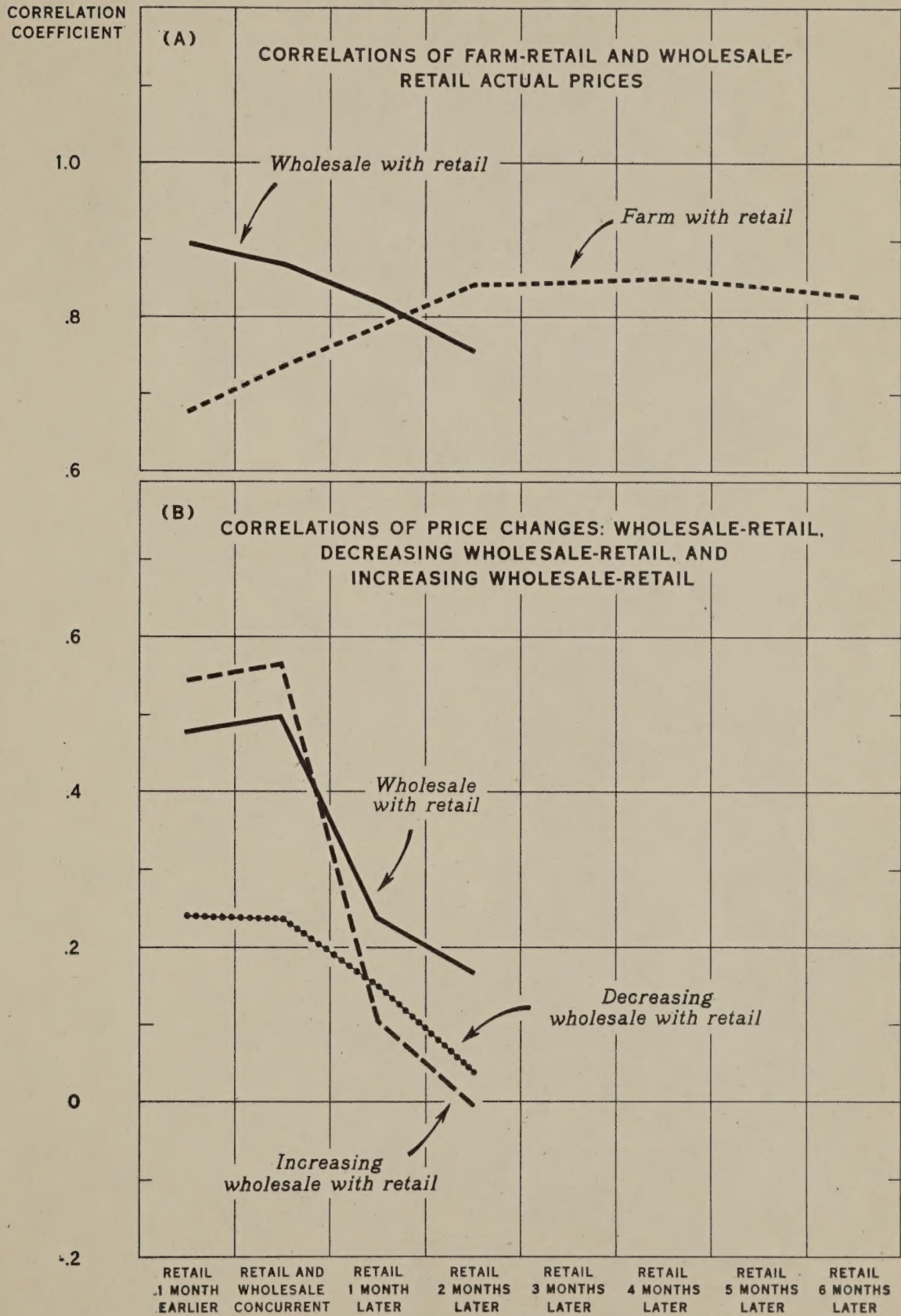
ORANGES: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES AND PRICE CHANGES WITH THOSE AT RETAIL, LAGGED FOR DIFFERENT PERIODS*



*CORRELATIONS ARE FOR PERIOD JAN. 1931-DEC. 1941.

Figure 9

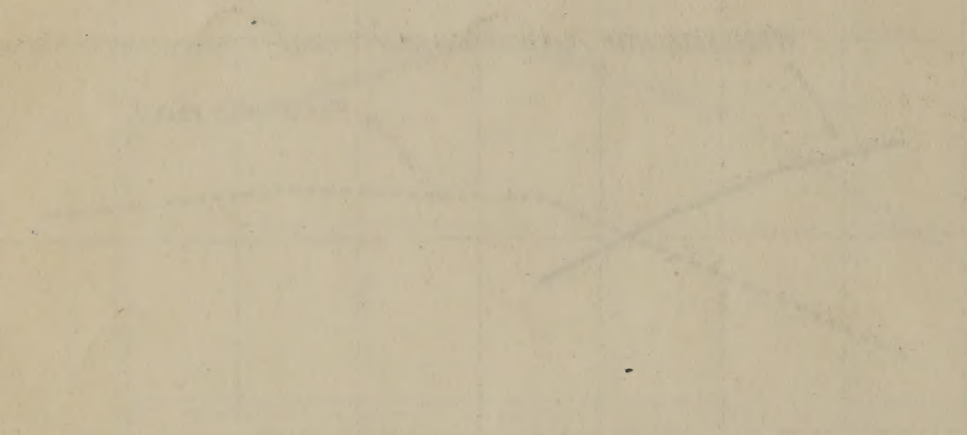
BREAD: RESULTS OF CORRELATING FARM AND WHOLESALE PRICES AND PRICE CHANGES WITH THOSE AT RETAIL, LAGGED FOR DIFFERENT PERIODS*



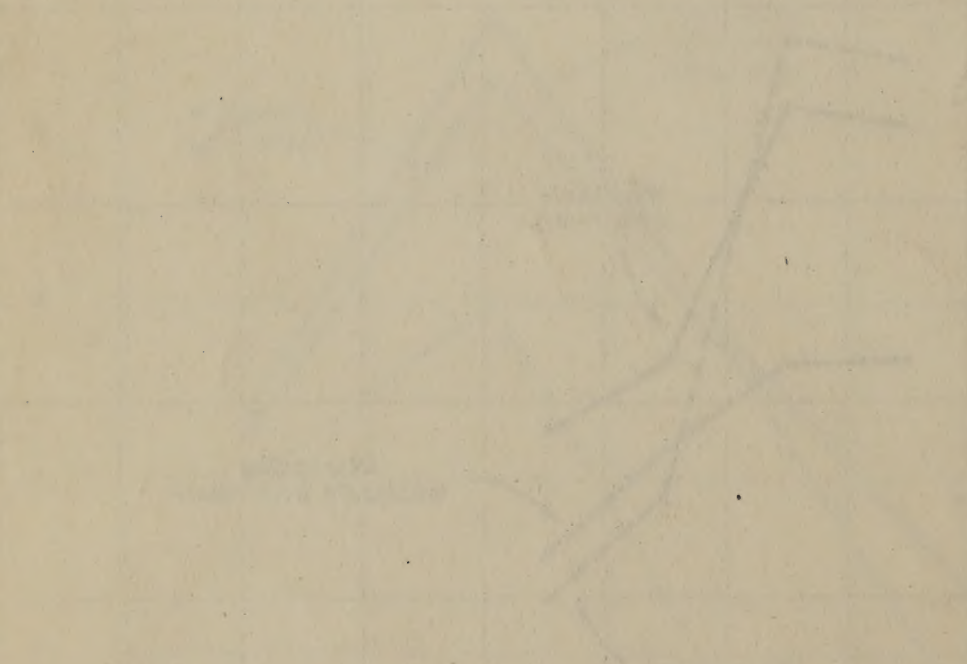
* WHOLESALE-RETAIL, JAN. 1931-DEC. 1941; FARM-RETAIL, JAN. 1931-MAY 1942

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